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## THE WHEELER GEOLOGICAL SURVEY OF NEW MEXICO FOR 1874.

BY E. D. COPE.

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THE Engineer Topographical and Geological Survey west of the 100th meridian, under Lieut. Geo. M. Wheeler, left Pueblo during the month of July for the prosecution of their labors in New Mexico. It was divided into eight parties, of which six were primarily topographical and two devoted to geological and biological investigation.

Of the former one only, that under charge of Lieut. Blunt, operated east of the Rocky Mountains, while the remaining five surveyed from the Colorado line, or near it, southward as far as the Rio El Rito and Cañon Apache, in the following order: at the north Lieut. Marshall; then Wheeler, Whipple, Birnie, and last, Lieut. Price. The last named officer having been incapacitated by sickness was succeeded in charge by Mr. Klett. The two remaining parties were assigned extensive territorial areas, as the nature of their work required widely extended reconnoissances, as well as studies in special localities, the position of which could not be foreseen. Dr. Rothrock was in charge of a party which explored the botany and zoology of southern Arizona and New Mexico, and Dr. Yarrow and Prof. Cope investigated the geology and paleontology of the northern portion of the latter territory.

We propose to speak of the work of the last named party at present, as several of the others have not yet come in from the field. Dr. Yarrow having left for Washington about the middle of September, according to previous arrangement, the direction devolved on the writer. The results obtained have been highly interesting and important to geological science. An analysis of the structure of the region traversed between Pueblo and Santa Fé was accompanied by successful collecting of fossil remains in many of the strata. Thus the Cretaceous beds near the Huerfano yielded many fine fossil shells and teeth of extinct fishes, and the carboniferous limestone of the Sangre del Christo pass was found to be equally rich. A unique collection of a large number of most beautifully preserved invertebrate remains was procured

from the same formation near Taos. Below the Picoris Mountains the sand beds and bluffs of the Pliocene formation fill the valley of the Rio Grande. These are the deposits of a lake of comparatively modern age, and in some localities they abound in remains of the skeletons of the animals that inhabited the surrounding continent at that time. Mastodons of species quite different from that so frequently found in the Eastern states were found to be abundant, while camels and horses had evidently existed in droves. One of the most singular discoveries was that of deer which did not shed their horns, as do modern species of that type. There is abundant reason to believe that they were frequently broken off in combats, so that while some individuals of a species had solid horns like the giraffe, others of the same species had them united by a suture with a burr like the deer. To keep the herbivorous animals in check, there were several species of wild dogs, while a large vulture allied to the turkey buzzard was prepared to eat them when life had departed, as the fossil remains demonstrate.

After concluding the investigation of this basin, the geologist was enabled through the courtesy of Gen. Gregg commanding the district of New Mexico, to make an exploration of the geology of the region at the northern end of the Zandia Mountains, forty miles south of Santa Fé. Here numerous fossil remains were found, including those of the hairy elephant, *Elephas primigenius* (var. *Columbi*). The party, after examining the geology of the Eastern Jemez mountains, passed north to Abiquiu on the Rio Chama and through the cañon Canjelson to Tierra Amarilla.

The writer had been led to suspect the existence of a tertiary lake basin on the divide of the drainage of the Chama and San Juan rivers, and had already published his belief that the rich life of the Eocene period of Wyoming had been preceded by older forms, which had lived upon older territory in the southern regions of the great basin. This position was fully confirmed by my discovery in the region in question of an enormous mass of lacustrine deposits of some 3000 feet in thickness, which cover an area of at least 3000 square miles (probably more) which includes remains of the oldest mammalian fauna of the continent, and which corresponds with the lowest of the fossil bearing beds of Wyoming. About 100 species of vertebrate animals were obtained, of which two-thirds are mammalia, and a large percentage new to

science. The crocodiles were very numerous and turtles swarmed. The mammalia did not embrace many of the modern classes, but exhibit, according to the preliminary reports published by direction of Lieut. Wheeler, characters of orders of which little has been known. The largest species were those of the genus *Bathmodon*, of which five species were discovered, which range from the size of the Indian rhinoceros to that of the tapir. They resembled closely the elephants in the structure of the feet and legs, but the tapir and the bear in the characters of the skull. They were armed with most formidable tusks, and their crania were solid and well thickened to repel attack. Besides these there were numerous species more nearly resembling the tapirs, and in some remote degree the horses, of a more harmless type, while a numerous population of carnivora restricted the increase of the rest. Sixteen species of flesh-eating forms were found, some of them minute, and others of powerful make, but all far removed from the existing types, and more or less related in structure to other kinds of quadrupeds, especially to those of insectivorous habits. Some of them possessed teeth of extraordinary strength, and were apparently bone breakers, while the excessively worn condition of the teeth and tusks of some others indicate hard diet and friction against resisting bodies. An order of very peculiarly constructed animals was represented by several species. These had much the structure of the gnawing order (*Rodentia*) in their dentition, which, however, includes many peculiarities, but resembled some of the hoofed animals in their feet. The only known example of this order (the *Toxodontia*) had been previously obtained from the late tertiary deposits of South America.

The boundaries of this lake basin were pretty well determined, and attention directed to the structure of the hill and mountain regions which constituted its shores. Among these were found marine and fresh water formations, containing abundant fossil remains, with beds of lignite of fifty feet or more in thickness. One of the lake deposits contains an abundance of petrified wood, while a lower formation was found to contain the teeth and bones of saurians of large proportions, and apparently of greater antiquity than those heretofore obtained in the West.

The brilliant colors of some of the strata observed are very remarkable, and the scenery is rendered highly picturesque by the escarpments of obliquely elevated strata, which traverse the coun-

try for sixty miles and more, parallel to the mountain axis. Most curious are the remains of human dwellings which stand in lines on the summits of these rock crests, and almost all the more inaccessible and remote points of the hills. They were often found standing on the summits of ledges of from five to twelve feet in width, with precipices of several hundred feet in depth on one or both sides; or occupying ledges on the sides of precipices forming the walls of cañons, in positions only accessible by perilous climbing. These localities are often remote from water, in some cases more than twenty miles.

The party collected and brought within reach of transportation about a ton of fossil remains. They crossed directly from the Rio Puerco to Conejos over the San Juan Mountains by a pass some twenty miles in length, where they were overtaken by a severe snowstorm. They returned to Pueblo on the 11th of November.

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### REVIEWS AND BOOK NOTICES.

EMBRYOLOGY OF THE CTENOPHORÆ.<sup>1</sup> — The development of certain jelly fishes (Ctenophoræ) belonging to the genera *Idyia* and *Pleurobrachia* has been elaborated in this memoir with great care and beauty of illustration by Mr. A. Agassiz. He gives a connected account of their history from the earliest stages in the egg until all the features of the adult appear. While the mode of segmentation of the yolk is extraordinary, the embryo attains the adult form without any metamorphosis, the changes being very gradual. Mr. Agassiz's observations, with the preceding ones of Müller, Gegenbaur, Kowalevsky and Fol, give us a tolerably complete view of the mode of development of this order of jelly fishes. These Ctenophoræ on our coast spawn late in the summer and fall. The young brood developed in the autumn comes to the surface the following spring nearly full-grown, to lay their eggs late in the summer. The autumn brood most probably passes the whole winter in deep water, and it must take six to eight months for the young to attain their maturity. The memoir closes with

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<sup>1</sup> Embryology of the Ctenophoræ. By Alexander Agassiz, with 5 plates and figures printed in the text. From the *Memoirs of the Amer. Acad. Arts and Sciences*, x, Aug. 1874. 4to, pp. 41.